[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7258 **L**

Unique Paper Code : 2173550008

Name of the Paper : DSE: Transition Metal Cluster - Introduction and Applications

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : VIII

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any **four** questions.
3. **All** questions carry equal marks.

1. a) Briefly explain the Polyhedral Skeletal Electron Pair Theory (PSEPT).
   b) Discuss the general methods of preparation of metal cluster compounds.
   c) Explain why the metal-metal bond length change is very small for the metal clusters of rhenium even though the bond order changes. $Re_2Cl_4(PMe_2Ph)_4$, $Re_2Cl_4(PMe_2Ph)_4^+$, $Re_2Cl_4(PMe_2Ph)_4^{2+}$.

   (5, 5, 5)

2. a) Using the 18 electron rule, calculate the total no. of M-M bonds, no. of M-M bonds per metal and draw the structure of
   i) $Fe_2(CO)_9$
   ii) $Os_3(CO)_{12}$

   b) Briefly outline the differences between Metal–Ligand Complex and Heteronuclear Cluster.
   c) Define Wade's rules. Discuss their application in analyzing the structure of the metal clusters.

   (5, 5, 5)

P.T.O.

3. a) With suitable equations give the synthesis of multidecker Sandwich complexes of metallocarboranes.
   b) Discuss the mechanistic aspects of Water gas shift reaction catalyzed by $Ru_3(CO)_{12}$.
   c) Using (14n+2) rule, predict the structure of following high nuclearity carbonyl compounds
   i) $Rh_6(CO)_{16}$
   ii) $Os_5C(CO)_{15}$

   (5, 5, 5)

4. a) Define quadruple bond and give one example. Using molecular orbital theory and suitable example, explain the formation of quadruple bond.
   b) Define zintl ion clusters .Why they are referred as naked clusters? Explain with one example.
   c) Define isolobality. What is the significance of this concept? What are isolobal fragments and frontier orbitals? (5, 5, 5)

5. a) Define intercalation. Why $Mo_4Ru_2S_8$ fails to form intercalated compounds?
   b) Compare a multi-decker sandwich complex with a standard metallocene. Which organic ligands are most commonly used to "bread" these sandwiches?
   c) Give the electron count in Pb_5^{2-} and Sn_9^{4-} and indicate the type of structure possessed by these zintl ions.

   (5, 5, 5)

6. Write short notes on any **three**
   a) Carboranes
   b) Metalloboranes
   c) Chevrel compounds
   d) Infinite metal chains

   (5, 5, 5)